Thermal emission from an active metallic photonic crystal

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A quantum optics approach coupled with plane wave expansion and transfer matrix techniques is used to calculate the thermal emission from an active 3D metallic photonic crystal. The emitting source is modeled as a collection of inhomogenously broadened two-level systems that is allowed to equilibrate via collisions to a Maxwell-Boltzmann distribution at a specific temperature. Emission and absorption processes create a photon population within the photonic lattice as dictated by the photonic lattice bandstructure. This population is then coupled to the exterior to give the output of the active photonic crystal. The outcoupling of the intracavity radiation is investigated with different schemes: passive photonic filter, photonic crystal cavity coupler, and in terms of the modes of the 'universe'. A similar treatment of the blackbody is conducted and the results are compared to those of the photonic lattice. Discussions pertaining to the consistency of the results with the second law of thermodynamics are addressed.

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